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B3C

Selected US specifications from IPC sub-classes B23B
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(54) Cutter for cutting flat
bottomed hole in road

(57) The cutter has a housing rotated about a predetermined axis supporting a series of peripheral cutters 9 clamped in sockets defined by the housing. Each peripheral cutter 9 defines a first cutting edge 11 extending substantially parallel to but spaced radially from the axis, and a second cutting edge 12 extending transversely relative to the axis and inwards from the end of the first cutting edge 11 remote from the housing. At least one further cutter 14 is clamped in a socket defined by the housing so as to be located within a surface of revolution described by the first cutting edges 12 of the peripheral cutters. The further cutter(s) define(s) a cutting edge(s) 15 extending transversely relative to the axis, so as to sweep out substantially the area within the surface of revolution not swept out by the second cutting edges 12 of the peripheral cutters. A pilot drill may be provided to stabilise the cutter. The peripheral cutters may have integral counterboring edges or separate cutters provided.

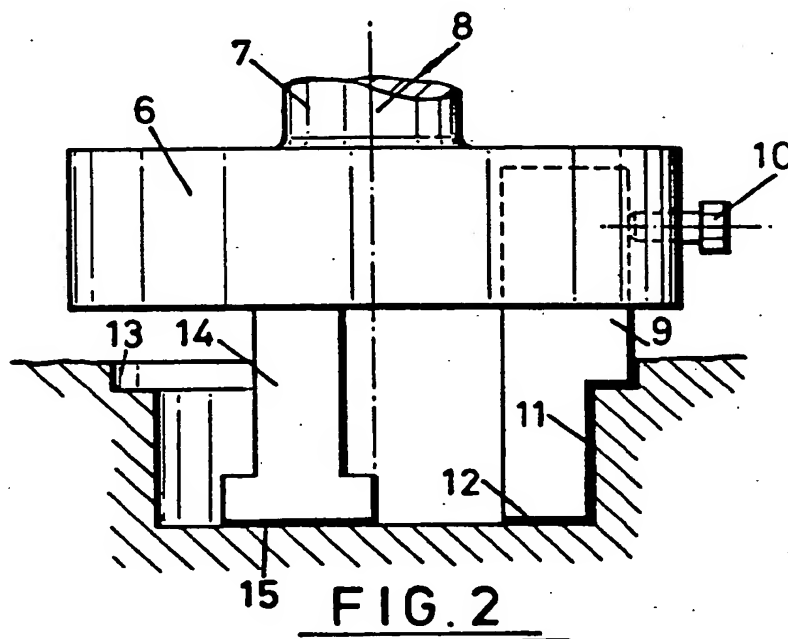
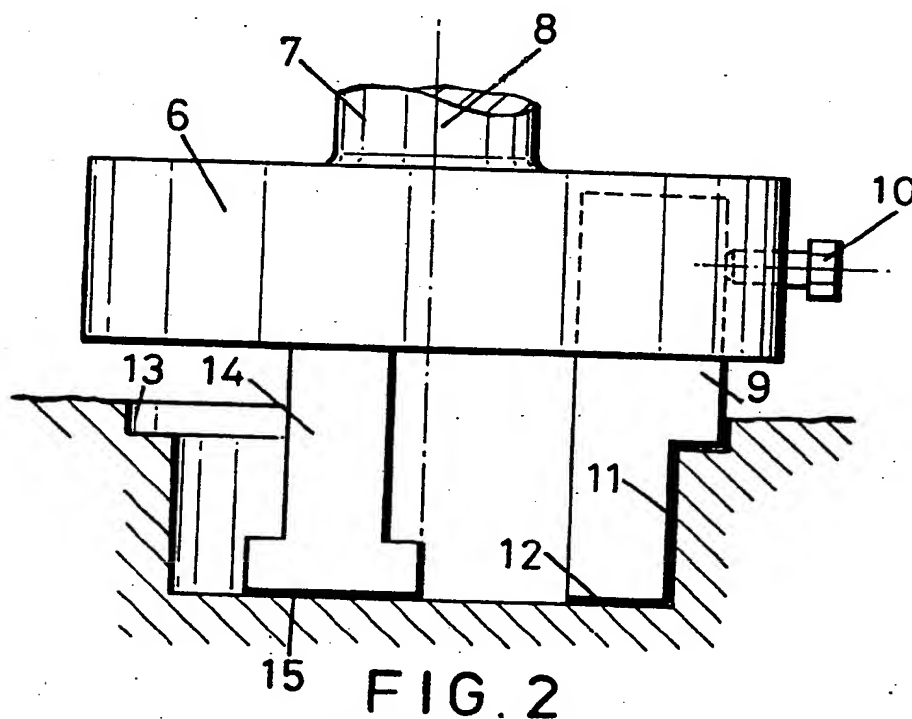
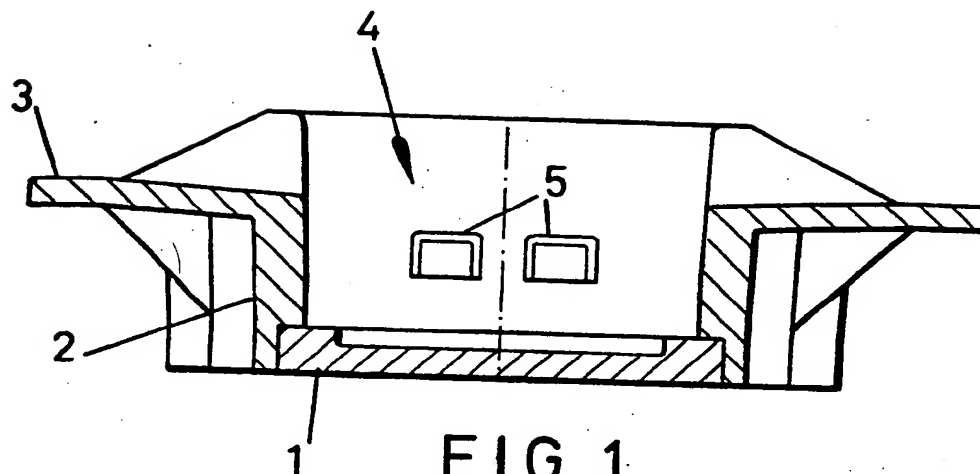


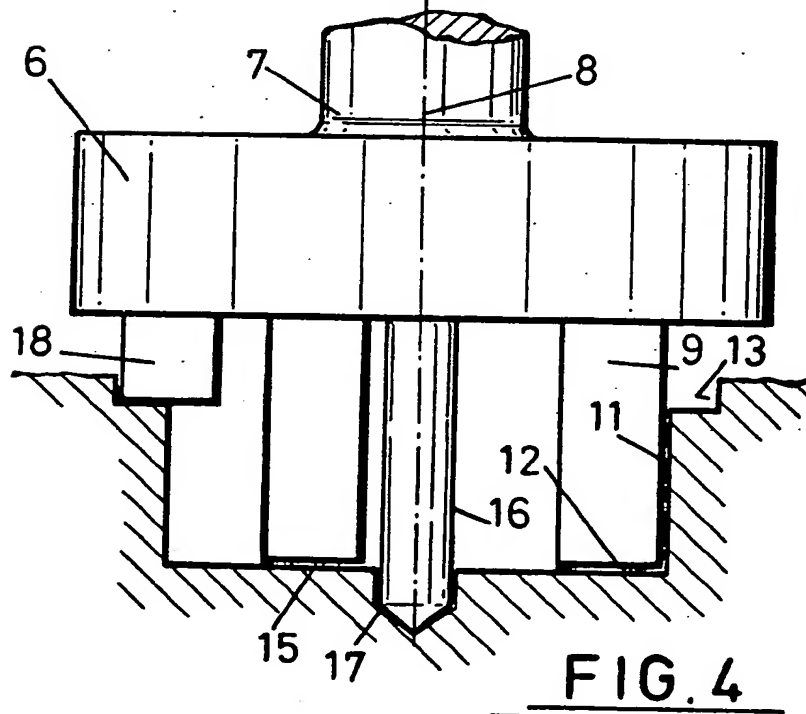
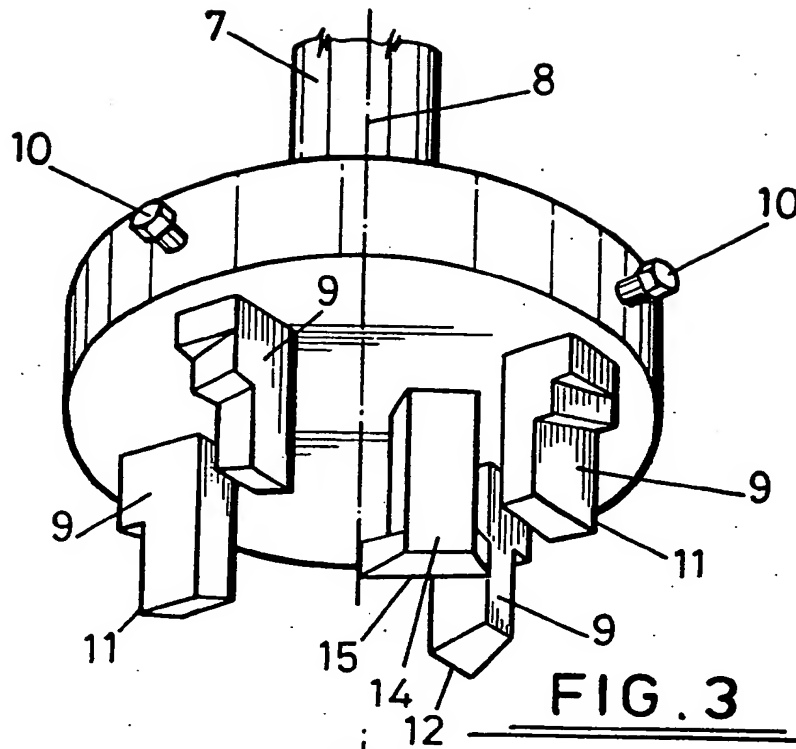
FIG. 2

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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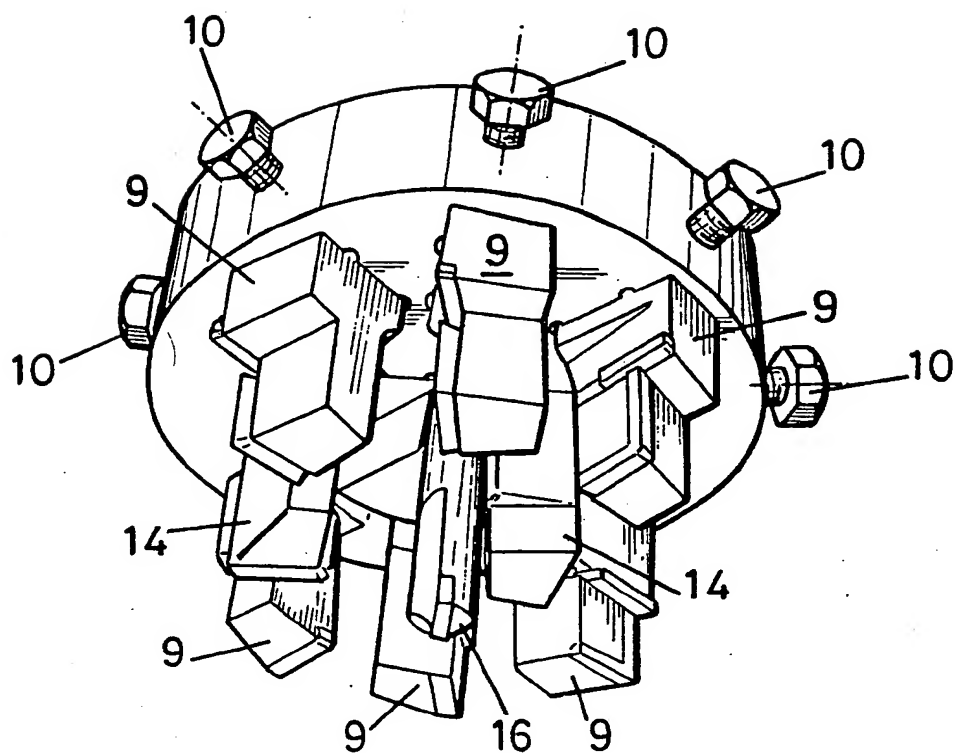


FIG. 5

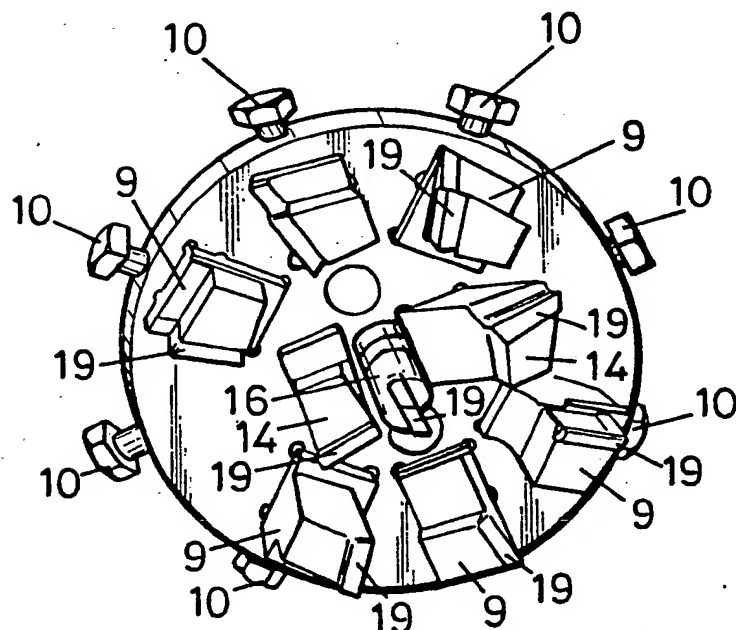


FIG. 6

SPECIFICATION

Cutting tool

- 5 The present invention relates to a cutting tool for cutting a flat bottomed hole in a road surface.

- It is conventional practice to embed retro-reflective "road studs" in a road surface.
- 10 Such reflecting road studs are generally referred to by the Registered Trade Mark "Catseye". The road stud structure comprises a depressable rubber insert incorporating retro-reflective beads, and a cast iron housing
- 15 which is generally oval when viewed from above and which receives the insert. It has recently been proposed to replace the oval cast iron housing with a housing which is circular when viewed from above, the housing comprising a cylindrical body extending downwards from a peripheral flange. The positioning of such a housing in a road surface requires the formation of a round hole having a well defined counter-bore around its open end
- 20 to locate and receive the flange. After the hole has been formed it is dried and partially filled with molten bitumen. The body of the housing is then twisted into the hole so that a thin layer of bitumen fuses between the housing and the road to anchor the housing in position.

- It has been proposed to form the required hole by using two concentric cylindrical diamond core bits, the inner cylinder penetrating the road surface to the full depth required by the housing and the outer cylinder penetrating the road surface just far enough to create the required counter-bore. This approach does present two problems however. Firstly, diamond core bits require continuous water cooling and lubrication during the cutting operation and the rate of cut is relatively slow. After withdrawal of the bit the material remaining within the core must be removed mechanically
- 40 with a hand or powered chisel device. This leaves a hole with a very uneven base so that the amount of bitumen required to fill the space between the housing and the bottom of the hole cannot be predetermined. Secondly, lubrication of the drill bits inevitably means that after the drilling operation the hole is wet and it is difficult to remove the slurry of broken material from the hole and dry the hole out. If bitumen is introduced into a hole which
- 50 has not been thoroughly dried it will not adhere sufficiently to the inner surface of the hole to secure the housing in position.

- It is an object of the present invention to provide a cutting tool which enables holes to be cut in a road surface without encountering the above problems.

- According to the present invention, there is provided a cutting tool for cutting a flat bottomed hole in a road surface, comprising a
- 65 housing which in use is rotated about a pre-

- determined axis, a plurality of peripheral cutters clamped in sockets defined by the housing, each peripheral cutter defining a first cutting edge extending substantially parallel to the axis and spaced radially therefrom, and a second cutting edge extending transversely relative to the axis and inwards from the end of the first cutting edge remote from the housing, and at least one further cutter
- 70 clamped in a socket defined by the housing so as to be located within a surface of revolution described by the first cutting edges of the peripheral cutters, the or each further cutter defining a cutting edge extending transversely relative to the axis so as to sweep out the area within the said surface of revolution not swept out by the second cutting edges of the peripheral cutters.

- At least four peripheral cutters should be provided, and preferably six peripheral cutters are provided. The cutting edge of the or each further cutter is preferably formed so that it describes a surface which is a continuation of the surface described by the second cutting edges of the peripheral cutters. The first cutting edges of the peripheral cutters may be stepped outwards adjacent the housing so as to cut a counter-bore adjacent the open end of the flat bottomed hole. Alternatively additional cutters may be provided clamped to the housing so as to cut out the counter-bore.

- A pilot drill may be clamped to the housing to stabilise the cutter against transverse vibrations, the pilot drill axis extending along the
- 100 axis of revolution.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

- 105 *Figure 1* is a section through a plastics housing intended to receive and retain a depressable retro-reflective road stud insert;

- Figure 2* is a schematic partial side view of a cutting tool in accordance with the present invention;

- 110 *Figure 3* is a perspective view of the cutting tool shown in Fig. 2;

Figure 4 is a partial side view of an alternative embodiment of the present invention;

- 115 *Figure 5* is a perspective view from below and to one side of a further embodiment of the present invention; and

Figure 6 is another perspective view of the embodiment of Fig. 5.

- 120 Referring to Fig. 1, the illustrated road stud housing comprises a bottom wall 1, side walls 2 and an upper flange 3. The housing defines a cavity 4 into which lugs 5 project. The cavity and lugs are dimensioned so as to be suitable for receiving a conventional depressable retro-reflective road stud insert of the type available from Reflecting Road Studs of Boothstown, Halifax, England.

- The housing illustrated in Fig. 1 requires a
- 130 circular hole with a small counter-bore around

its open end. Such a hole may be cut with the tool in accordance with the invention illustrated in Figs. 2 and 3.

Referring to Figs. 2 and 3, the illustrated cutting tool comprises a housing 6 which is mounted on a drive shaft 7 so as to be rotatable about axis 8. Four peripheral cutters 9 are clamped to the housing by bolts 10, each peripheral cutter defining a first cutting edge 11 extending parallel to the axis 8 and a second cutting edge 12 extending perpendicular to the axis 8. The first cutting edge is stepped outwards so as to enable the formation of a counter-bore 13. In the illustrated example there are four of the peripheral cutters 9.

A further cutter 14 is provided which defines a cutting edge 15 extending substantially perpendicular to the axis 8. The cutting edge 15 describes a surface which is a continuation of an annular surface described by the cutting edges 12 of the peripheral cutters 9. The cutting edge 15 thus sweeps out substantially all of the area within the cylindrical hole which is not swept out by the second cutting edges 12 of the peripheral cutters. The shape of the hole resulting from use of the cutting tool illustrated in Figs. 2 and 3 can be seen from Fig. 2.

As shown in the drawings, the various cutters are secured in sockets defined by the housing by means of bolts 10. The precise shape of the cutters and the sockets into which they engage should be such that the cutters are securely held against movement relative to the housing when subjected to vibration as a result for example of variations in the hardness and density of a road surface into which a hole is being cut. It may be however preferable to limit transverse vibration of the cutting tool so as to reduce the transverse forces on the cutters by incorporating a pilot drill as shown in Fig. 4.

Referring to Fig. 4, a pilot drill 16 is clamped to the housing 6 so that its tip projects beyond the cutting edges 12 and 15 of the cutters 9 and 14. This stabilises the position of the axis 8 of the cutting tool relative to the bore 17 cut by the tip of the pilot drill 16.

A further difference between the structures of Figs. 2 and 4 is that in the embodiment of Fig. 4 the first cutting edge 11 of the peripheral cutters 9 is straight and the counter-bore 13 is cut by separate cutters 18 mounted on the housing 6. This simplifies the manufacture of the peripheral cutters 9 but does require an increase in the number of cutters and cutter-receiving sockets in the housing 6.

Figs. 5 and 6 illustrate a further embodiment of the present invention incorporating features of the embodiments of Figs. 2 and 3 and of Fig. 4. The same reference numerals are used in Figs. 5 and 6 as in Figs. 2 to 4. The embodiment of Figs. 5 and 6 comprises six

peripheral cutters 9, each having stepped cutting edges so as to form the required counter-bore 13. A pilot drill 16 guides the assembly, and two further cutters 14 are arranged on opposite sides of the pilot drill. One of the further cutters is stepped radially outwards so that the two further cutters 14 together sweep out substantially all of the area located radially inwards relative to the peripheral cutter 9. Each of the cutting edges is formed from an insert 19 of a hardened material to improve resistance to wear.

After a hole has been cut with one of the illustrated tools the resultant flat bottomed hole is dry and of accurately predetermined capacity. Accordingly a measured amount of bitumen or other sealant/adhesive can be poured into the hole. A road stud housing of the type illustrated in Fig. 1 is then pushed into the hole, forcing the bitumen up around the body of the housing so as to lock it in position. The flange of the housing is received in the counter-bore 13.

The cutting edges 12 and 15 sweep out the area within the surface of revolution defined by the cutting edges 11. Where there is a pilot drill 16 the cutting edges 15 of necessity terminate at their radially inner edges short of the drill. Furthermore, it is not essential for the cutting edges 12 and 15 to sweep out all of the surface which forms the bottom of the hole. It has been found that if there is a gap between adjacent edges of the cutting edges 12 and 15 of a few millimetres, for example 7 millimetres, the projections formed between the adjacent edges of the cutters tend to shear off on the plane of the bottom surface of the hole again leaving a flat bottomed easily cleaned dry hole.

It has been found that using a tool of the type illustrated enables a well defined hole to be formed in a single machining operation lasting of the order of 30 seconds. Thus road stud housings can be inserted very rapidly with a high degree of reliability and without requiring complex drying and cleaning equipment.

CLAIMS

1. A cutting tool for cutting a flat bottomed hole in a road surface, comprising a housing which in use is rotated about a predetermined axis, a plurality of peripheral cutters clamped in sockets defined by the housing, each peripheral cutter defining a first cutting edge extending substantially parallel to the axis and spaced radially therefrom, and a second cutting edge extending transversely relative to the axis and inwards from the end of the first cutting edge remote from the housing, and at least one further cutter clamped in a socket defined by the housing so as to be located within a surface of revolution described by the first cutting edges of the peripheral cutters, the or each further cut-

- ter defining a cutting edge extending transversely relative to the axis so as to sweep out the area within the said surface of revolution not swept out by the second cutting edges of the peripheral cutters.
- 5 2. A cutting tool according to claim 1, comprising at least four peripheral cutters.
3. A cutting tool according to claim 2, comprising six peripheral cutters.
- 10 4. A cutting tool according to any preceding claim, wherein the or each further cutter is formed so that it describes a surface which is a continuation of the surface described by the second cutting edges of the peripheral cutters.
- 15 5. A cutting tool according to any preceding claim, wherein the first cutting edges of the peripheral cutters are stepped outwards adjacent the housing so as to cut a counter-bore adjacent the open end of the first bottomed hole.
- 20 6. A cutting tool according to any one of claims 1 to 4, wherein additional cutters are provided clamped to the housing so as to cut out a counter-bore adjacent the open end of the flat bottom hole.
- 25 7. A cutting tool according to any preceding claim, comprising a pilot drill clamped to the housing to stabilise the cutter against transverse vibrations, the pilot drill axis extending along the axis of revolution.
- 30 8. A cutting tool substantially as hereinbefore described with reference to Figs. 2 and 3, Fig. 4 or Figs. 5 and 6 of the accompanying drawings.

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